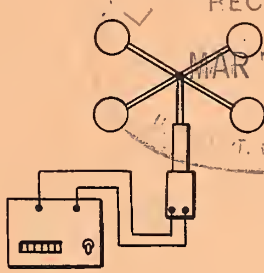
TECHNICAL EQUIPMENT REPORT NO. F-2

MAY 5, 1958

TOTALIZING WIND COUNTER FOR CONTACTING-TYPE ANEMOMETERS

BY

DIVISION OF FOREST FIRE RESEARCH
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA



FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

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Introduction

About 95 percent of the wind observations taken at fire-weather stations are recorded manually. The 1/60 mile contacting-type anemometers are used with a buzzer or a flashing light and a watch to count the number of contacts (fig. 1). Generally, this is done for a two-minute interval three times a day, the results are averaged, and the afternoon wind is calculated. The other 5 percent of the wind observations are taken on Weather Bureau dial-type anemometers which mechanically sum the passage of wind during the afternoon period. This equipment is expensive, however, and could not be used at all fire-weather stations.

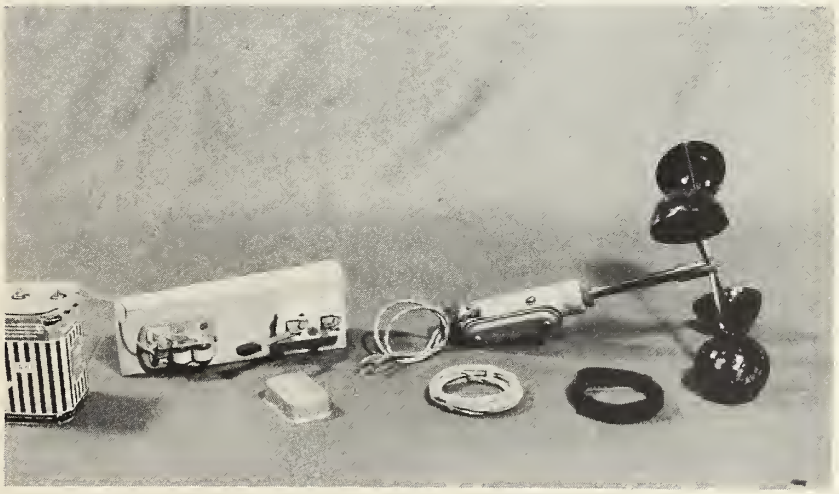

Figure 1. Buzzer-type anemometer.

Objectives

1. Modernize equipment.
2. Increase the ease of handling by the observer.
3. Obtain consistent and reliable data.
4. Design a low-cost replacement unit.

The general objective of this equipment development project is to modernize the wind measuring system at fire-weather stations. Incorporated in this objective is the desire to make the new system as automatic as possible, thus reducing the risk of human error. Also, the old buzzer or flashing light method is awkward to use and time consuming, which increases the chance of getting pseudo wind observations.

In order to meet all the objectives, an electrical system seems the most practical. Mechanical methods must be used at the exact location of the anemometer, while an electrical circuit can be a remote operation.

Development History

After searching the market for suitable electric wind counters, it became apparent that none were available which were economical and could be used with the 1/60 mile contacting-type anemometers at fire-weather stations. The counting circuit needed to include certain features to be acceptable for lookout operations. Thus the unit had to be operated by a dry cell, and it had to incorporate a means of saving current discharge when the anemometer was becalmed and the contact closed. Furthermore, the counter had to respond to wind speeds of at least 60 mph, and it could not record the chatter found in all pressure-contact anemometers. The unit needed to be durable enough to withstand the climatic conditions at lookouts and fire-weather stations. Lastly, the components of the counter had to be readily available on the open market and inexpensive enough to make the replacement of the buzzer systems feasible.

Advice from electronic labs and private research firms was sought, but none of the suggestions proved acceptable. A cooperator proposed a counter that seemed usable. The circuit diagram and related information was passed on to the Forest Service Radio Laboratory. They investigated the circuit and found it satisfactory, and they found several local manufacturers who could produce the counter for approximately $15.00. With this confirmation, and with the price low enough, the next step was to get the counters field tested.

During the summer of 1956, the California Forest and Range Experiment Station conducted a wind survey. The circuit diagram was sent to them, and they had 12 units constructed. The counters worked satisfactorily as long as an input voltage of 4.5 to 6 volts was maintained. Later they built several units and placed them at fire-weather stations.

Several prototypes were built and tested for chatter reaction and endurance (fig. 2). The housing was a simple aluminum box 5 inches long by 3 inches wide and 2-5/8 inches deep. One unit was used by Montana State University's Wildlife Division on an elk survey, and the counter worked perfectly all winter, even at temperatures as low as -38° F. During the summer, the prototypes functioned properly at maximum temperatures of about 95° F. Two counters were tested at the Priest River Experimental Forest against a single register recorder using the same anemometer. They were found to check perfectly. Laboratory tests proved the electrical circuit eliminated the danger of chatter or multiple counts. A variable resistor was used to compensate for line loss; however later findings proved a booster battery worked better when the operating voltage dropped below 4-1/2 volts.

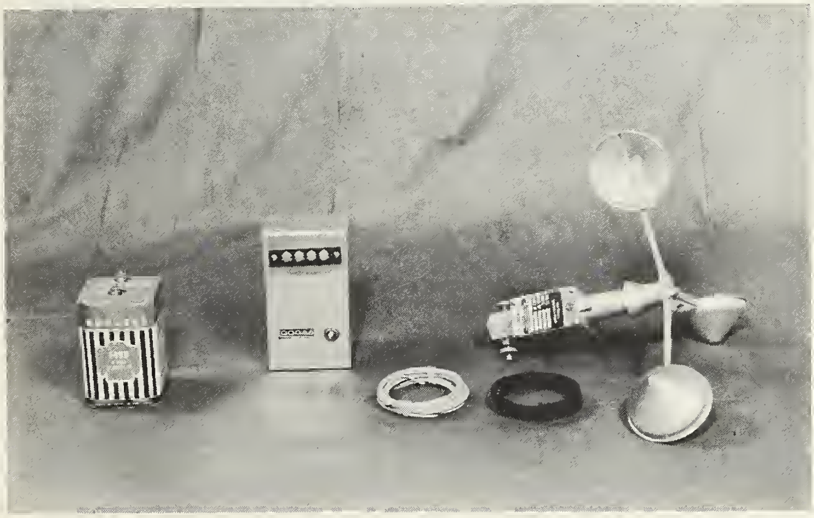

Figure 2. Early model wind counter.

During the summer of 1957, 12 units were built and tested. There were no failures. Twenty-two more were built and included in the instrumentation of the portable fire-weather station (fig. 3).

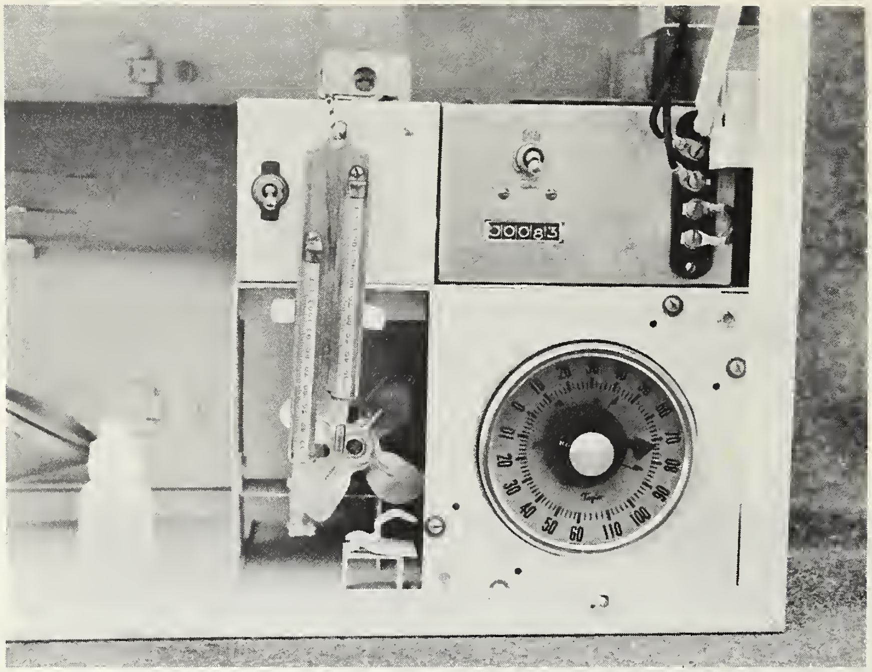

Figure 3. Totalizing wind counter in upper right of portable fire-weather station.

Circuit Operation

The attached circuit diagram shows the wiring of the counter. The component parts are: a relay with an SPST contact; a 4-terminal board; a non-reset counter; a 500 ohm resistor, 1-watt, wire-wound; a 100 microfarad capacitor, paper, 30 volts DC; an SPST toggle switch; a 6-volt dry cell; and appropriate wiring.

The circuit functions as follows: When the anemometer contact closes, capacitor C1 charges through the resistance of the SPST normally-open contact relay K1. Relay K1 is thus energized for approximately 100 milliseconds, the charge time of C1. Its contacts, S1, thus energize the digital counter K2 for about 30 milliseconds (which is sufficient to indicate one unit on the counter). As long as the anemometer is closed, and after K1 has cycled, there will be only a 12 milliamperes current drain through the 500 ohm shunt resistor. When the anemometer contact opens, the discharge current from C1 through K1 and R1 is not sufficient to again energize K1.

If the anemometer contacts should chatter after the initial closing, the lag of relay K1 and the delay circuit C1, R1, will prevent the circuit from responding to frequencies greater than 3 contacts per second. This delay is sufficient to prevent spurious counts due to contact chatter.

If the anemometer should stop with the contact closed, there will be a steady 12 milliamperes holding current through R1. A dry cell can easily sustain such a current well beyond the expected calm periods where this counter would be used.

Method of Observation

The totalizing wind counter does, therefore, meet all the objectives stated above. The unit makes use of a simple electrical circuit which is dependable and cheap (estimated total cost about $15). Use of an automatic counter eliminates some of the human error involved in observations. The following steps are used when reading the wind counter:

1. Record the count and the time.
2. Turn the toggle switch to the ON position.
3. Let the counter run the desired length of time. The longer it runs, the more accurate will be the calculated afternoon wind.
4. Turn the toggle switch to the OFF position.
5. Record the count and the time.
6. Calculate the wind speed by dividing the elapsed count by the elapsed time in minutes. This will give the average wind velocity in miles per hour.

The total wind time used by the buzzer system is only 6 minutes. The totalizing wind counter can be run for several hours while the observer does his other field duties. A simple form would make the recording of wind velocity an easy matter with little chance of error.

Recommendations

We recommend that the totalizing wind counter be used at fire-weather stations instead of the buzzer or flashing light system.